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## FISH CULTURE IN RICE FIELDS\*

MESSRS. HOFSTEDE AND ARDIWINATA have done a great service to the countries harassed by food shortage and depending upon rice cultivation for their sustenance, by their compilation of statistical data on fish culture in irrigated rice fields in West Java. They have not only assessed the possibilities of various methods, but have also given convincing data of the practicability of these methods. They rightly observe: "Very often the possibilities provided by the irrigated rice fields for the production of fish are still greatly underestimated, in which connection also the interests relating to the local economy and the food production are entirely overlooked."

There are vast areas in the deltaic regions of India where there must be immense possibilities of producing more fish in rice fields and at the same time increasing the yield of much needed paddy crop. In this practice, two factors are of primary importance: (i) the supply of water for the paddy fields, and (ii) the effect of fish culture on rice cultivation, which is, of course, the primary purpose of these fields.

Fish production in rice fields has been classified as follows:

1. *Catch on Irrigated Rice Fields*.—This represents a wild crop estimated at 3 kg. per hectare in a six months period. Even at this low production figure, 2 million hectares of rice fields in Java would yield 6,000 tons of fish per annum.

2. *Fish Rearing as a Secondary Crop*.—This method signifies an alternate raising of two different crops on the same piece of land, and thus corresponds to the paddy and prawn culture practice in Cochin and Travancore. "In actual practice the theoretical production figure per hectare per annum, may be put at roughly 300 kg." of fish.

3. *Fish Culture between Harvest and Planting*.—In West Java, there is arrangement for perennial irrigation, hence the fields can be used continuously. Usually, three harvests are taken every two years. The interval between harvesting and planting is partly used for drying up the fields and partly for short-term fish culture.

4. *Mixed Rice Cultivation and Fish Culture*.—In this system, fish is reared as a "catch crop" during a longer or shorter period on the paddy field whilst the rice is actually growing. According to the "fish growing system" in West Java, a farmer may use his rice field as a nursery or a rearing pond. For example, fry of 1-3 cm. are introduced in a rice field for 20-40 days and fingerlings are harvested.

\* Hofstede, A. F. and Ardiwinata, R. O., "Compiling Statistical Data on Fish Culture in Irrigated Rice Fields in West Java," *Landbouw*, 1950, 12, p. 469-94.

Some farmers stock fingerlings of 3-5 cm., 5-8 cm. or 8-12 cm. for periods of 20-40 days, and either sell them as fingerlings of the larger size or raise them to consumption size of 12-20 cm., each weighing 50-75 grammes.

To give practical demonstration of the utility of fish culture in paddy fields, the Extension Service of Indonesia entered into an arrangement with the farmer, "by which the Service was to prepare a number of the paddy plots worked or owned by him, for fish culture, either in combination with his rice cultivation or merely as such. The costs of the materials used and laying out of the plots, and also the costs of any possible decrease in his rice crop, were to be for account of the Fishery Service. The fish so produced was to be given to the farmer". This is by far the best method of demonstration, and the writer as Director of Fisheries, Bengal, had also advocated such an approach.

From experiments thus conducted, data on the following items were collected: (i) cultivation schedule; (ii) paddy varieties; (iii) growth of fish and percentage of losses sustained; (iv) species, individual weights and number of fish stocked; (v) fish production; (vi) length of rearing period; (vii) cultivation methods; (viii) assessment of production, both on fish plots and on the surrounding plain plots, by means of test cuts on marked squares, measuring  $10 \times 10$  sq. m.; (ix) planting distance of the paddy and (x) elevation, class of paddy field, system of irrigation, etc.

Messrs. Hofstede and Ardiwinata then give an account of the results obtained both from piscatorial and agricultural observations, and record a series of experimental data in detail. From the analysis, they conclude:

1. In the period between the second weeding and the flowering of the paddy, it is quite practicable to have a fish culture lasting 40 to 60 days and to produce within this period 30-50 kg. of fish per hectare. "As a general average one may assume in this form of pisciculture a theoretical annual yield per hectare of 300 kg."

2. The dark carp showed more favourable results than gold carp in this method of fish culture.

3. "In all demonstrations discussed, it is evident that the yield of rice (expressed in the weight of the wet paddy immediately after harvesting) is not inconsiderably increased through the application of this form of fish culture." The average increase noted is 6.3 per cent., and it is attributed to (i) increased tillering action, (ii) control of the growth of weed, (iii) manurial value of fish excreta and (iv) the

extra care the farmer takes for the double crop.

In a postscript, the authors draw attention to the importance of the character of the soil and give hints for the use of the Extensive Service personnel. They recognise the paucity of their data for statistical purposes, and strongly advocate that "the combined method of growing paddy and rearing fish should certainly be studied more closely within the compass of measures of this improved growing method".

"Finally it will be necessary to test the statement made by farmers that this form of fish culture has a limiting effect upon rats. It is well known that rats multiply in masses about the time of the flowering of the paddy. The rats inhabit deep holes in the bunds also in those bordering the paddy fields whereas on the one hand the heightened and strengthened bunds required for the combined rice growing and fish culture, provide the rats with a better opportunity to dig runways and nests, on the other hand the higher water level will prevent them from digging such holes and will inundate those they already have made."

At the meeting of the United Nations Scientific Conference for the Conservation and Utilization of Resources in 1949, Dr. E. de Vries and Dr. C. J. Bottemanne also gave an account of fish cultural methods practised in the rice fields of Indonesia, and characterised them as "the most intensive type of cultivation". At the same Conference, Mr. Yoshio Hiyama contributed a paper on "Rice-Paddy Carp Culture in Japan", in which he indicated the lines along which further research should be carried out for increasing the productivity of fish in rice fields. According to Hiyama, "this is one of the best methods of utilizing the natural fish productivity of well fertilized, warm fresh water areas with abundant natural food. *It is also a way of supplying animal protein for the farmer*" (italics ours). Lin, at this Conference, referred to this practice in China and Hofstede in Indonesia, and stated that the benefit to paddy crop may be as much as 10 per cent increased yield or even more. In a letter dated the 26th January 1944 to the writer, Dr. C. L. Pan, Chief Delegate, Chinese Agricultural Mission to India, stated:

"I would, however, like to bring it to your notice that in China, which is a big rice producing country, there are many indigenous devices and new developments in cultural operations to improve the paddy crop. *The most ingenious of all perhaps is the Fish Breeding in Paddy Fields. This controls one of the most serious Insect Pest trouble of our Paddy Crop,*

namely, the *Stem Borer*. The yields have thus been noticed to have increased by about 10-15 per cent. Furthermore, there are clear indication of fish eating up *Mosquito Larvæ*, thus check their *Breeding and Spread of Malaria*." (italics ours).

An experiment on Paddy-cum-Fish Culture was started in Bengal in 1945 and in order to facilitate reference in future, its results may be given at this place.

The scheme was set in operation in May 1945 and the data for the district of 24-Parganas are given below\*:

Area of paddy fields brought under the scheme	..	691.16 acres
Carp fry stocked in the a-ove area	..	4 07 100
Size of fry stocked	..	3"-24"
Cost of fry	..	Rs. 4,502-10-0
Cost of transport of fry	..	Rs. 1,124-8-0
Total number of fish harvested	..	2,24,158
Range of size of fish recovered	..	5"-12"
Total weight of fish recovered	..	Mds. 785-34-10
Value at Rs. 40 per maund	..	Rs. 31,463-6-0

Of the fry stocked, 56,850 had been planted in tanks adjoining the paddy fields, and it is remarkable to note that the growth of tank fishes was slower than those liberated in the paddy fields. Some fish had grown to 16" in rice fields while the largest fish recovered from the tanks was only 11". It was estimated that, taking into consideration the full annual production of the fish stocked into the ponds, the total production figure from the scheme may have gone upto 3,000 maunds of fish at the end of one year.

In the district of 24-Parganas, the scheme was taken up for the second year towards the end of April 1946 with a grant of Rs. 9,140. Upto the end of May, the staff went round selecting suitable places and explaining the objects of the development scheme. The scheme envisaged the free distribution of carp fry to farmers who undertook to strengthen the bunds for fish culture in paddy fields. During the next quarter, nurseries for fish larvæ were set up and paddy fields for conducting experiments were inspected. Fry were distributed in September-October to three working units as under:—

1. *Gosaba Units*.—38 paddy fields were approved and 2,31,700 fry of 1 to 2 inches in length were liberated into them. Total expenditure was Rs. 2,521-13-0.

2. *Port Canning Unit*.—36 paddy fields were approved and 2,07,000 fry of 1 to 2 inches in length were stocked into them. Total expenditure was Rs. 1,684-11-0.

\* One Maund is approximately equal to 82 lb. One Rupee is equal to approximately 1 sh. 6 d.

3. *Sreekrishnapore Unit*.—24 paddy fields were stocked with 1,45,000 fry of 1-2 inches in length. Total expenditure was Rs. 1,086-2-0.

Up to the end of November, the total expenditure incurred was Rs. 5,285-13-3, for stocking 98 paddy fields with 5,83,700 fry.

By a random sampling at 8 villages, it was found that Catla (*Catla catla*) had grown to 5"-8-3", Rohu (*Labeo rohita*) to 3½"-7" and Mrigal (*Cirrhina mrigala*) to 3"-5½". by the 15th November. It was observed that the fish showed a more rapid growth in paddy fields than in ponds. The following data of growth were obtained from the Gosaba Model Farm. The fish were stocked on the 1st September and harvested on 15th November 1946.

	Size of fry	Average growth in tank	Average growth in paddy field
Catla	1-7"	6-0"	7-8" (9-0" largest)
Rohu	1-5"	5-0"	6-2" (7-3" largest)
Mrigal	1-4"	5-2" (old tank)	6-2" (7-0" largest)

The survival rate was 34 per cent. Catla; 37 per cent. Rohu and 39 per cent. Mrigal. This shows that bottom living Mrigal was somewhat safe from predatory birds even in these shallow waters. Mrigal was also found to be useful for the tillering of paddy but the best results for increased production of paddy were obtained when all the three species were stocked together.

About 972.6 maunds of fish had been recovered by 6th September 1947, besides a large number of young fish that had been stocked in tanks and channels of the Abad areas. Only taking the quantity of fish that was recovered at Rs. 40 per maund, fish worth Rs. 38,905 was produced at a total cost to the Government of Rs. 5,292-10-0. Though no share of it went to Government, the farmers of the area had so much protein food at such a small cost to the public revenue.

The Rice Committee of the FAO, in its meeting at Baguio, Philippines, in 1948 strongly advocated the practice of fish culture in rice fields for the increased production of rice. Now that Messrs. Hofstede and Ardiwinata have given details about various methods of fish culture in irrigated rice fields and have demonstrated statistically the benefit to the rice crop, it may be hoped that India will also take up this programme of food production in a more systematic way, and on a more comprehensive scale.

S. L. HORA,

## PHYSICS AND AESTHETICS OF HINDUSTHANI MUSIC\*

THE glory of Indian melodic art-music, both Hindusthani and Karnatic, lies in *Gamakas* (movements or graces), which form really their aesthetic feature. The nature of the graces and their physical counterpart in the matter of the slight rise and fall in pitch of notes which it engenders, are the real matters for scientific research in the melodic music of India. Conclusions on theoretical bases are not of much value, and the living art music should be studied by accurate and objective methods known to modern physics, to ascertain the scientific laws behind the art. The studies should be undertaken in collaboration with a physicist of sound knowledge and photographic curves should be obtained by suitable means of *Gamakas*, played true on a violin or vina, to the satisfaction of competent judges.

Considered from this point of view, the recent publication of Mr. Ranade appears rather disappointing. The author perhaps intends the book more for the benefit of the Western reader since no mention has been made in the text of the names of the six Hindusthani *Thats* (seven note ragas) (or the six model scales at page 97) nor of the names of the *svaras* (notes) entering into their composition in Hindusthani nomenclature, except to a small extent in the appendix. His references to flats, double flats, sharps and double sharps of D, E, F, A and B and the European signs affixed thereto (pp. 96 and 97) leave the reader bewildered as they are not used with their accepted meaning<sup>1</sup> though the vibrational values against basic 240 c.p.s., for C, are given.

Following Helmholtz's method of evaluation against the basic 1 of C (*Shadja*) the relative frequencies of the seven notes in the above 6 Ragas, arrived at by the author on theoretical considerations of consonance with the drone—a necessary accompaniment in Indian melodic art-music—are noted below:

1 <i>Bilawal</i>	1	9/8	5/4	4/3	3/2	27/16	15/8	2
2 <i>Khamai</i>	1	9/8	5/4	4/3	3/2	5/3	16/9	2
3 <i>Kafi</i>	1	9/8	6/5	4/3	3/2	27/16	9/5	2
4 <i>Asaveri</i>	1	9/8	6/5	4/3	3/2	8/5	16/9	2
5 <i>Bhairavi</i>	1	16/15	5/4	4/3	3/2	8/5	15/8	2
6 <i>Bhoiravi</i>	1	16/15	6/5	4/3	3/2	8/5	9/5	2

The omission as a model scale, of Yaman or Kalyani, one of the seven ancient Grecian scales, is surprising, since that Raga is sung largely both in the North and the South of India.

\* Hindusthani Music: An outline of its Physics and Aesthetics by G. H. Ranade (Published by the Author, Poona), 2nd Edition, 1951, Pp. 204 + 8. Price Rs. 5.

Items 1, 3, 5 and 6 have the two tetrachords in the relation of the fifth, while those of Items 2 and 4 have the relation of the fourth. The diatonic or major scale of European music, based on the sound principle of major chords from C (*Shadja*), F (*Suddha Madhyama*) and G (*Panchama*) has R.F.'s of 1, 9/8, 5/4, 4/3, 3/2, 5/3, 15/8 and 2; and the author's 'Bilawal' scale is the same except that he substitutes for R.F. 5/3, R.F. 27/16. If R.F. 10/9 is substituted for R.F. 9/8, in the diatonic scale the principle of the relation of the fifth in the two tetrachords is satisfied and the result is that all the notes are musical notes including R.F. 10/9 adjudged to be so both by Helmholtz<sup>2</sup> and the Karnatic musician. In fact these are the frequency values at which the frets have been placed on the South Indian vina (with fixed frets) under the *Shadja* and *Panchama* strings.

Why should not the 'Kafi' scale have R.F.'s 1, 10/9, 32/27, 4/3, 3/2, 5/3, 16/9 and 2, also satisfying the enunciated principle of the fifth in the two tetrachords? The author seems to have entirely ignored the possible existence in the first four scales of R.F. 10/9 in the region of D which is found in the early Grecian scales and in the Arabic scales.<sup>3</sup>

The above observations have been made to apprise the reader that the notes of scales are only the skeleton frame-work round which we have to clothe the melody and that the *raga* concept is entirely different from the *scale* concept. It does not really matter whether the notes in the scale are a comma sharper or flatter in the matter of the description of the scales. Hence it is that Venkatamakhi fixed his 72 possible scales in relation to the 12 fixed frets of the vina in the octave as  $4C_2 \times 4C_2 \times 2$ .

The author's statements at p. 132 that (1) the major sixth (R.F. 5/3) has an imperfect dissonance with the tonic in item 4 and (2) the minor sixth (R.F. 8/5) has a perfect dissonance with the tonic in item 5, are certainly incorrect. There is perfect consonance with the tonic in both cases.<sup>4</sup>

The author is rather hard on Karnatic music. A misstatement of fact has, however, to be pointed out. There are not merely 19 parent scales in which Karnatic melodies exist to-day. The great Thiagaraja (1767-1847 A.D.) has created melodic compositions in 45 parent scales (of the 72) and in 220 derivative ragas including those in the less known parent scales even now known and sung by the erudite.

In spite of these criticisms on the purely scientific side, the book will certainly be found



to be of general interest. It contains a good account of the evolution of Indian Music from the Vedic times and also a bibliography of books for further study.

C. S. AYYAR.

1. Sir James Jeans, *Science and Music*, 1937, p. 166; Helmholtz, *Sensations of Tone*, Ellis' Translation, 1930, p. 17. 2. Helmholtz, *Ibid.*, p. 17. 3. *Ibid.*, pp. 284, 515, 516. 4. *Ibid.*, pp. 14, 332, (Items 29 and 28) and 333, note under table of roughness.

## USE OF NITRIC ACID IN THE PRODUCTION OF PHOSPHATE FERTILIZERS

IN view of the difficulties that might arise in maintaining adequate supplies of sulphuric acid to the fertilizer industry, the Chemical Research Laboratory, Teddington, has been studying for the past two years the possibility of making phosphate fertilizers by methods which might effect a saving in the amount of sulphuric acid used. The most obvious alternative to sulphuric acid is nitric acid, for its production does not call for the use of imported raw materials, while the nitrogen value of the acid is recoverable in the form of a nitrogenous fertilizer, and this offsets to some extent the greater cost of the acid as compared

with sulphuric acid. Unfortunately, the action of nitric acid on phosphate rock leads to the production of fertilizer containing much calcium nitrate, which is a highly hygroscopic substance and causes the fertilizer to become damp and difficult to use. Consequently, the work at the Chemical Research Laboratory has largely been confined to the use of mixtures of nitric and sulphuric acids. Actually it has been found that products made in this way are more stable to atmospheric conditions than when nitric acid is used alone. The maximum amount of nitric acid which can be tolerated in order to give a product having a low absorption of moisture is when the mixture of acids contains about 2 mol. of nitric acid to one of sulphuric.

\* Courtesy of *Nature*, May 19, 1951.

## RESEARCH FELLOWSHIP AWARDS

AT a recent meeting of the Council of the National Institute of Sciences of India, the following awards of Research Fellowships, which are normally for two years, were made:—

**NIS Senior Research Fellowships:** Dr. A. M. Nagvi, Ph.D., "Solar Problems" at the University of Delhi; Dr. S. C. Shome, Ph.D. (Dacca & Cantab.), "Corrosion of Metals" at the National Metallurgical Laboratory, Jamshedpur; Dr. B. G. L. Swamy, D.Sc. (Mysore), "The Comparative Morphology and Relationships of Some of the Families of the Order Ranales," at the Madras University.

**NIS Junior Research Fellowships:** Mr. D. Basu, M.A., "The Waldian Approach to the Problems of Estimation," at the Indian Statistical Institute, Calcutta; Dr. M. Datta, D.Phil., "New Probabilistic Approach to the Basis of Statistical Physics," at the Calcutta University; Dr. A. M. Mehta, D.Phil. (Oxon.), "Investigation of Biles (from Slaughter-Houses in Bombay) with a View to Search for 11 and 12 Oxygenated Steroids Needed for Synthesis of Anti-Arthritic Compounds Related to Cortisone," at the Haff-

kine Institute, Bombay; Dr. A. K. Mukherjee, M.B., D.T.M., "Cultivation of *E. histolytica* in a Bacteria free Medium," at the Indian Institute for Medical Research, Calcutta; Dr. (Mrs.) T. S. Sarojini, Ph.D. (Madras), "Studies in Soil Fungi with Special Reference to Fusarioid Disease of *Cajanus*," at the Madras University; Mr. E. G. Silas, B.Sc. (Hon. Madras), "the Zoogeography of the Western Ghats as Evidenced by Distribution of Fishes," at the Madras University; Mr. T. B. Sinha, M.Sc. (Alld.), "the Morphology and taxonomy of Mites," at the Allahabad University.

**ICI (India) Research Fellowships:** Dr. B. K. Banerjee, D.Phil. (Cal.), "Physico-chemical Studies of Glass," at the Indian Association for the Cultivation of Science, Calcutta; Dr. A. Ganguli, Ph.D. (Edin.), "Investigation on Potato Virus Diseases," at the Bose Institute, Calcutta; Dr. P. T. Rao, D.Sc. (Waltair), "Complex Molecular Spectra of the Transition Groups of Elements (in the Near-Infrared and the Visible)," at the Andhra University, Waltair.

## LETTERS TO THE EDITOR

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ELECTRONIC BANDS OF  
PARADIBROMOBENZENE

PARADIBROMOBENZENE belongs to the symmetry class  $V_h$  like the corresponding molecule *paradichlorobenzene*. According to ideas developed by Sponer in interpreting the structure of benzene and of substituted benzenes, the near ultra-violet electronic transition  $A_{1g} \rightarrow B_{2u}$  of benzene becomes  $A_{1g} \rightarrow B_{3u}$  in *paradibromobenzene* with the dipole moment in the molecular plane and perpendicular to the *para* carbons. The transition is an allowed one with the migration moment parallel to *x*. About 60 bands have been measured in the region  $\lambda 2840$  to  $\lambda 2570$ , in the absorption spectrum of the substance photographed in the vapour state at different temperatures, the

substance being enclosed in a special all-quartz tube. The main features confirmed the theoretical predictions. The 0, 0 band is located at  $\lambda 35643$ . Four definite frequencies of the upper state 470, 677, 1014 and 1449  $\text{cm}^{-1}$  have been identified. Bands are detected corresponding to difference frequencies 21 and 86  $\text{cm}^{-1}$ . As in *paradichlorobenzene* the bands occur in a number of different groups. The strongest bands in these groups are found to be associated with a number of close-lying bands on the long wavelength side.

Detailed analysis will be published elsewhere. Physics Dept., K. SREERAMAMURTY, Andhra University, Waltair, October 15, 1950.

MOLECULAR DIFFRACTION UNDER  
HIGH VACUUM

PARAFFIN was slowly evaporated at a temperature slightly above its melting point through a rectangular aperture ( $1'' \times \frac{3}{4}''$ ) in the apparatus already described by the author.<sup>1</sup> At pressures of the order of  $10^{-4}$  cm. Hg, patterns similar to optical diffraction patterns were obtained (Figs. 1 and 2) with either a central maximum or a central minimum.

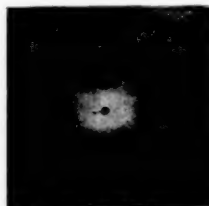


FIG. 1



FIG. 2

As in the case of the periodic deposits described earlier<sup>1</sup> the results suggest that the phenomenon is to be ascribed to a wave-like character of the streaming particles. By using the formulae,  $\lambda = aw/d$ , where  $a$  is the length of a side of the rectangular aperture,  $w$  is half the width of the central maximum or minimum in the deposit and  $d$  is the distance between the collecting plate and the aperture, the wavelength is calculated to be 1.4 mm. and the corresponding wave-number is  $7.3 \text{ cm}^{-1}$  which is probably due to the rotational oscillation of a part of the molecule about the other part.

The experiment has been repeated using brass and glass plates as collecting plates and the results were reproducible showing that surface action cannot be the origin of the phenomenon.

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Ravenshaw College,  
Cuttack-3 (Orissa),  
March 30, 1951.

BRAHMANANDA MISHRA.

1. Mishra, B., *Ind. J. Phys.*, 1951, 25, 57.

EXPERIMENTAL EVIDENCE FOR THE  
EXISTENCE OF TRANSVERSE  
THERMAL WAVES IN LIQUIDS

A CALCULATION<sup>1</sup> of the hypersonic velocity in glycerine from the Doppler-shift of frequency of monochromatic light in Brillouin scattering due to coherent fluctuations of density, gave a value of 2,500 metres per second at  $26^\circ \text{C}$ . as against a value of 1967 m/sec. at  $28.5^\circ \text{C}$ . for an ultrasonic frequency of about  $10^7 \text{ sec}^{-1}$ . This observed increase of velocity in the hypersonic region has

been adduced as evidence showing that glycerine behaves like a rigid solid for such frequencies. From the rigidity modulus derived from the two velocities, the time of relaxation has been calculated and found to have a value of  $4.2 \times 10^{-10} \text{ sec.}$ , which is greater than the vibration-period of the hypersonic wave, namely  $0.64 \times 10^{-10} \text{ sec.}$  In the same circumstance, one should expect the existence of transverse waves also in the liquid; but a search for the transverse components in Brillouin scattering was unsuccessful.

On the basis of the 'hole theory' of liquids, Frenkel<sup>2</sup> has shown that the rotational vibrations of anisotropic molecules about their centre of gravity in a liquid body should give rise to three types of scattering, namely (1) a purely angular part, (2) a translational-angular part of the longitudinal type, referred to as  $l_a$  and (3) a translational-angular part of the transverse type, referred to as  $t_a$ . These three constitute depolarised "anisotropic scattering". The  $l_a$  and  $t_a$  types of motions of molecules should give rise to Doppler-shifted components and unmodified components in light-scattering, in the same way as the purely translational motions.

Interferometric studies<sup>3</sup> of monochromatic light from a zinc arc scattered by several liquids have shown that, besides the well-defined Brillouin components due to 'density waves' and a depolarised background due to purely 'rotational scattering', there exists a continuous band between the central component and the two Brillouin components on either side. The intensity of this continuous band depends on the optical anisotropy of the molecule. It is best observed in liquids like ethyl alcohol and acetone whose depolarisation ratio,  $\rho$ , lies between 0.15 and 0.30; for higher values of  $\rho$ , it tends to be masked by the rotational scattering. The origin of this continuous band was not clear at the time of publication of the results. Applying Frenkel's theory, it becomes clear that this continuum arises from a Brillouin scattering by the transverse ( $t_a$ ) waves in the liquid, broadened out by damping, and provides experimental evidence for the existence of transverse thermal waves in liquids.

A weak unmodified depolarised component is to be expected due to "entropy fluctuations" of these transverse (or  $t_a$ ) waves. In fact my studies<sup>4</sup> have shown that the central component in Brillouin scattering is not perfectly polarised, as it should be if it were due to the density scattering only. This observation of a feeble depolarisation of the unmodified component has been confirmed by later workers.<sup>5</sup> This

lends additional evidence to the view that transverse thermal waves are present in liquids.

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May 28, 1951.

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### PRODUCTION OF JOSHI EFFECT IN IODINE VAPOUR UNDER X-RAYS

A NEGATIVE Joshi-effect ( $+\Delta i$ ) was observed by Joshi<sup>1</sup> in chlorine on irradiation by X-rays. Recently Saxena and Karmalkar<sup>2</sup> have reported for iodine vapour  $-\Delta i$  with visible light but only a positive Joshi-effect  $+\Delta i$  under X-rays. Studies in these Laboratories<sup>3,4</sup> under a wide range of operative conditions of a number of excited media have, however, shown the production of both  $\pm\Delta i$ . Table I is a typical set of data, observed with excited iodine vapour, employing an experimental technique similar to that of Joshi.

TABLE I  
Exciting potential = 4.5 kV (r.m.s.)  
Current in dark iD = 82.0 (arbitrary units)

Anode Voltage in kV	Tube current in mA									
		0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
10.8	% $\Delta i$	-2.8	-7.3	-10.0	-2.9	-1.0	-0.6	-0.0	+1.7	+3.5
13.9	% $\Delta i$	-8.6	-12.0	-14.8	-8.0	-5.0	-2.5	-1.8	-0.4	+1.0
17.0	% $\Delta i$	-12.8	-17.8	-21.2	-12.5	-8.3	-5.6	-4.8	-2.8	-0.8

The following important results emerge out of this work: (1) whilst  $-\Delta i$  is definite enough under X-rays, its range of occurrence and magnitude are determined by (a) applied potential; (b) nature and concentration of the excited material; (c) intensity and hardness of the X-rays; (d) frequency response of the detector circuit. (2) The relative Joshi-effect ( $-\% \Delta i$ ) increases with the increase in the voltage on the X-ray tube. (3) With the increase of the intensity I,  $-\Delta i$  rises from an almost negligible value at low I, to a maximum at a tube current of about 2.0 mA; thereafter it decreases and then remarkably enough changes sign at

high I (6 to 9 mA). A like reversal to  $\pm\Delta i$ , at large I (tube current, 12 mA) is observed in bromine vapour also. The optimum intensity I depends, *inter alia*, on the electron affinity of the excited medium.

Saxena and Karmalkar have not indicated the hardness and especially the intensity of their X-ray beam; it is very likely that their results were made under highly intense X-rays. Their explanation, which attributes the negative Joshi-effect exclusively to the negative ionic space charge would lead to its decrease with the frequency of X-rays, which is contrary to our finding.

The results can, however, be interpreted on Joshi's<sup>5</sup> theory supported by the analogous character of the ozoniser discharge and the corona. The h.f. pulses in the ozoniser discharge are similar to the Trichel<sup>6</sup> pulses observed in the corona. Each pulse is characterised by electronic motion during its rapid growth (the 'active time',  $t_a$ ) and the (positive) ionic motion during its slow decline (the 'clearing time',  $t_m$ ). Montgomery<sup>7</sup> have shown that  $i = Q/(t_a + t_m)$  in such a type of discharge where Q is the charge collected during a pulse. Electrons emitted during  $t_a$  produce Townsend avalanches, leaving behind an additional space

charge (B) between the initial space charge (A) and the cathode. This is similar to a two-sheath problem in a G.M. counter discussed by Wilkinson.<sup>8</sup> (B) reduces the field near the anode causing a decrease in Q and the pulse height. In addition  $t_m$  is increased due to the screening action of (B). Both these cause  $-\Delta i$ . Electrons emitted from the cathode during  $t_m$  enhance the positive ionic space charge increasing  $t_m$ . Thus irradiation during  $t_a$  and  $t_m$  results in  $-\Delta i$  and the decrease in the pulse height. On the above mechanism an increase in frequency and intensity of X-rays producing enhanced (B) should result in greater  $-\Delta i$ .



In certain cases, especially halogens, the electrons in the avalanche are captured by excited atoms to form negative ions. The enhancement of negative ionic space charge results in an increase<sup>10</sup> of  $V_m$  and  $1/i$  under irradiation.

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# OVERFOLDING OF THE UPPERMOST CUDDAPAH SOUTH OF KAREMPUDI

THE problem of the age of the Palnads is highly controverted on account of the absence of a recognisable unconformity in the southern limits of the Palnad formations. W. King<sup>1</sup> made a brilliant suggestion that there was reduplication of the Kistnah beds in the middle of the Waumyconda range, Guntur District. The present note gives an account of an observed overfold in the Kistnahs south of Karempudi, and this appears to indicate why no unconformity has been recognized in this area. In a pass called 'Nayakurali Alugu' in the Waumyconda range, the overfold is recognised with its axis and the recumbent folding. The fold pivots on the Irlaconda quartzite, which forms the axis of the fold. On either side of this are the Kolumnala slates with an interbanded quartzite. This is succeeded by the Sreeshailum quartzite. The fold is asymmetric; the beds towards the north of the axis being thicker than those to the south, with the beds on either side dipping south-east. At the junction of the Cumbum slates and the uppermost Cuddapah quartzites, slickensides and breccia are noted. The recognition of current bedding in a nearly vertical attitude in the Irlaconda quartzites of the fold definitely proves the uplifting of the beds and of folding.

These observations seem to indicate that subsequent to the deposition of the uppermost Cuddapahs, the beds were subjected to uplift resulting in the formation of an overfold and

subsidence took place from the northern fringe of the Waumyconda range at a later stage followed by the deposition of the Palnads. The Palnad beds are unaffected by tectonic movements that folded the Cuddapahs. It is therefore natural to expect that the Palnads do not overlie the uppermost Cuddapahs but occur flanking the folded formations of the Kistnah beds. The complete succession of the Palnads from the conglomerates to the limestones is however recognised in the Durgi and Manchikallu areas in the Palnad basin. The detailed geology of this area by one of us (G. V. U. R.) is under publication elsewhere.

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## MODE OF ACTION OF PALUDRINE

WITH reference to glucose utilisation of *P. gallinaceum* in the presence of paludrine, Marshall<sup>1</sup> concluded that paludrine exerted its antimalarial action at least partially by inhibiting the oxidation processes in the parasites but did not directly interfere with the breakdown of glucose. Wright and Sabine<sup>2</sup> observed that atebine has definite inhibitory action on tissue respiration and d-amino acid oxidase activity and inferred that atebine may be capable of competition *in vivo* for one or more essential proteins with flavine nucleotides. In this note is described the effect of paludrine on the respiration of malarial parasites, *P. gallinaceum*, and also on d-amino acid oxidase.

**Method.**—Measurements of oxygen consumption were made with a Warburg manometer of the classical type fitted with side-arm flasks of approximately 20 ml. capacity. The suspension medium was a phosphate buffer pH 7.3 of the following composition.

NaCl 0.0068M., KCl 0.0865M.,  $\text{Na}_2\text{HPO}_4$  0.0275M.,  $\text{KH}_2\text{PO}_4$  0.0025M.,  $\text{MgSO}_4$  0.0015M. Each flask contained a cell suspension of 0.5 ml. diluted to a total vol. 2.5 ml. Glucose was added to a final concentration of 0.0058M.

The parasitised blood was centrifuged and the cell washed twice in buffer salt solution containing the glucose and resuspended to the original blood vol. in the same medium.

D-amino acid oxidase was prepared as described by Krebs.<sup>3</sup> Sheep kidneys were ground, washed with acetone and stored in a vacuum desiccator. 0.5 g. of the kidney was ground with

sand and 15 ml. of water, centrifuged and the supernatant was used as the enzyme preparation.

**Results.**—The effect of paludrine on the respiration of chick's erythrocytes infected with *P. gallinaceum* is shown in Table I. The results of three experiments on the oxygen consumption of normal non-parasitised erythrocytes ( $1.3 \times 10^6$ ) show that 36 c.mm. of oxygen are consumed during a period of two hours.

Paludrine was tipped from the side-arm of the manometric flask, exactly 25 minutes after placing the flask in the thermostat.

TABLE I

+ Drug concn.	No. of expts.	Oxygen consumption in 2 hrs.	% of inhibition
Nil	4	153 C. mm.	..
$1 \times 10^{-5}$	4	145 "	5.2
$2.5 \times 10^{-5}$	4	97 "	36.6
$1 \times 10^{-4}$	4	52 "	66.0
$2.5 \times 10^{-4}$	4	15 "	90.2

**Substrate** Glucose 0.058 M; R.B.C.  $1.3 \times 10^6$ ; Temp. 38°C.; Gasphase Oxygen. % of Parasite 46; pH 7.3\*;

Table II gives the rate of consumption of oxygen during the oxidation of *dl*-alanine by *d*-amino acid oxidase in substrates containing paludrine as well as free from it.

TABLE II

Time in min.	10	20	30	40	50	60
Paludrine concentration	Oxygen consumption in c.mm.					
1 in 5000	..	27	43	61	81	101 119
1 in 2500	..	26	48	68	89	105 121
1 in 1500	..	25	45	62	81	99 112
Nil	..	29	49	71	91	107 130

**Substrate:** *dl* alanine (10%) 0.1 ml.

**Buffer:** M/10 Phosphate pH 7.4

Temp. 35°C. Gasphase Oxygen

The results show that paludrine even at very high concentrations has no appreciable effect on the oxidation of *dl*-alanine by *d*-amino acid oxidase. *d*-amino acid oxidase is a relatively stable representative of flavo-proteins capable of dissociation. Thus the mode of action of paludrine seems to differ from that of atebine in that atebine interferes with respiration possibly through the yellow enzymes whereas the inhibition of respiration by paludrine cannot be concluded to be due to the effect on flavo-

proteins, but might be due to interference with some other oxidative enzymes.

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### EFFECT OF REMOVING RESIDUAL MOISTURE FROM OVEN-DRIED SOILS ON THEIR PHYSICO-CHEMICAL REACTIVITY

THE present study relates to the effect of 'activation' treatment on some physico-chemical properties of a few typical soils.

The soils were rendered base-free by prolonged leaching with N/20 HCl followed by washing with water. After drying to a constant weight at 110°C., a portion of each soil was 'activated' by heating at 200°C. and passing through it a stream of dried air for 6 hours continuously.

The following properties of the soils were determined before and after the 'activation' treatment:—

1. **pH Value:** Soil suspensions in water in the ratio of 1 : 10, were shaken for 2 hours and the pH values determined using glass electrode.

2. **Titration Curves:** Increasing amounts of 0.1 N. NaOH solution were added to one gram portions of each soil and the volume was made 10 c.c., in each case. The pH values were determined after shaking the suspensions for 48 hours. The neutralisation values, equivalent to the amount of alkali required to raise the initial pH value by 4 pH units,<sup>1</sup> were interpolated from the graphs.

TABLE I

Effect of removing residual moisture on the pH, neutralisation and ammonia absorption values of soils

Soil No.	pH value		Neutralisation value		Ammonia absorption	
	(1)	(2)	(1)	(2)	(1)	(2)
	m.e./100 g. soil		m.e./100 g. soil		m.e./100 g. soil	
6	4.54	4.14	6.3	8.4	4.8	6.4
13	3.10	2.87	44.0	52.2	42.7	54.8
123	5.47	5.02	27.5	32.2	24.5	31.6
172	4.60	4.36	30.7	40.2	30.4	37.2

(1) Before removing residual moisture.

(2) After removing residual moisture.

TABLE II

Effect of removing residual moisture on the moisture absorption-vapour pressure relationships and heat of wetting of soils

Soil No.	Percentage moisture absorbed at different relative humidities							Heat of wetting
		10%	30%	50%	70%	90%	99%	
6	Before removing moisture	1.06	1.42	1.79	2.76	4.91	7.51	2.34
	After       "       "	1.56	1.80	2.11	3.25	5.22	9.63	3.93
13	Before       "       "	4.10	7.34	8.59	11.07	12.89	16.79	10.90
	After       "       "	4.60	7.58	8.93	11.97	13.85	18.33	14.74
123	Before       "       "	0.74	3.31	3.35	7.25	10.63	14.32	5.48
	After       "       "	1.48	4.41	5.29	8.01	11.22	16.94	6.66
172	Before       "       "	2.62	4.36	5.17	6.86	8.34	10.84	7.62
	After       "       "	2.86	4.65	6.05	7.80	9.54	12.25	9.90

3. *Ammonia Absorption Values*: 5 gram portions of the soils were kept in contact with excess of N. ammonia solution for 48 hours, then boiling off the excess and determining the amount retained by distilling with alkali.<sup>2</sup>

4. *Moisture Absorption—Vapour Pressure Relationships*: 5 gram portions of the soils were placed in desiccators containing  $H_2SO_4-H_2O$  mixtures corresponding to different relative humidities and the increase in weight determined when equilibrium was attained.

5. *Heat of Wetting*: 5 gram portion of each soil was mixed with 150 c.c. water contained in a thermos flask and the amount of heat developed was calculated from the rise in temperature recorded with a Beckmann thermometer.

Table I shows pH, neutralisation and ammonia absorption values and Table II hygroscopicity and heat of wetting. It is seen that the removal of residual moisture from soils leads to increased reactivity towards alkalies as well as increased hygroscopicity. This appears to be due to the availability of greater pore space which increases the 'active' surface of soils.

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### THE ENGINEERING PROPERTIES OF A CLAY SOIL OF WEST BENGAL

THE present note records the results (Table I) obtained with a clayey soil of West Bengal (collected from Hoogly and locally known as 'ahtel' soil), using the methods of Brown and Hogentogler.<sup>1</sup>

TABLE I

1	Grading (oven-dried basis):	
	(i) clay	.. 50.1%
	(ii) silt	.. 26.9%
	(iii) coarse sand	.. 4.7%
	(iv) fine sand	.. 17.2%
2	Moisture in air-dried sample	.. 6.3%
3	Apparent density	.. 1.6%
4	Moisture content of saturated soil	.. 38.3%
5	Pore space	.. 55.0%
6	Volume expansion	.. 25.4%
7	Field moisture equivalent	.. 27.0%
8	Shrinkage limit	.. 8.0%
9	Shrinkage ratio	.. 1.95
10	Lower liquid limit	.. 45.0%
11	Plastic limit	.. 21.7%
12	Plasticity index	.. 23.3%

A comparison of the data presented in Table I with the range of the numerical values of the physical constants of the different groups<sup>1</sup> of soils suggests that the soil in question belongs to the A-7 group (compare also Chatterjee<sup>2</sup>). The data also accounts for the observed properties of 'ahtel' soil. These are: plastic at certain moisture content; low internal friction; high expansion and shrinkage properties; can be compacted to high permanent density except at certain moisture content; may have considerable volume change and sometimes cause concrete pavement to crack and fault.

Since 'ahtel' soil belongs to the A-7 group, it is fairly suitable for foundation work and

earth-dam construction<sup>1</sup> and as fill material after stabilisation by densification, but not so for highway and airport construction; it can be used for these purposes *only after elaborate treatments*.

Further work on the stabilisation of this soil is in progress.

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salt. It may therefore be assumed that nearly half to two-thirds of the calcium in the seed are rendered unavailable.

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#### THE OXALATE CONTENT OF GINGELLY (*SESAMUM INDICUM*) SEEDS

GINGELLY SEEDS contain much more calcium than the other common oil seeds.<sup>1</sup> The nutritive value of the seeds has actually been attributed to this high calcium content.<sup>2</sup> The seeds, however, also contain a high proportion of oxalate<sup>3</sup> so that at least a part of the calcium would be unavailable physiologically. As it appears to be of interest to determine what proportion of calcium is rendered unavailable due to the presence of oxalate, the results of analysis for their calcium and oxalate contents of some gingelly seeds obtained locally are reported here.

The cleaned and crushed seeds, both white and black variety, were defatted by soxhletting with light petroleum, and dried for about half an hour at 100° C. Oxalate in the finely ground meal was determined according to Otto<sup>4</sup> and calcium according to Ranganathan, *et al.*<sup>1</sup> Calcium was also determined in the whole seeds. The following table gives the average values obtained:

	Average value for Ca (%)		Average value for oxalate in meal expressed in terms of its equivalent as Ca (%)	% of unavailable calcium
	in whole seed	in meal		
White	1.30	2.68	1.84	61.7
Black	1.38	2.48	1.16	46.8

The simultaneous occurrence of large amounts of calcium and of oxalate makes it highly probable that the main part if not all of the oxalate in the seed is present as its calcium

#### CHLORINATION OF ORGANIC COM- POUNDS UNDER SILENT ELECTRICAL DISCHARGE

ARISING out of earlier work<sup>1</sup> a series of results have been observed for the chlorination of organic compounds under electrical discharge, on which but little information can be had from the literature. Thus in its vapour phase, on chlorination in presence of sunlight, toluene yields benzyl (85 per cent.), benzal (6.8 per cent.), benzotri- (2.3 per cent.) chlorides, under a wide range of operative conditions. When, however, subjected to an ozoniser discharge due to A.C. potentials in the range 8 to 12 kV. of 50 cycle frequency, it was striking to observe that the above order is practically reversed. At 9 kV. and 50 cycles, the following yields were obtained in the case of toluene: 45 per cent. benzotri-, 25-30 per cent. benzal and 10-12 per cent. benzyl chlorides and some nuclear substitution products. These results could be obtained in about half the time when the frequency was changed to 500 cycles. Irradiation of the system or/and amplification of the surface volume ratio by introduction in the annular space of powdered wall material, are additional and potent parameters in respect of both the yield and nature of the reaction. Thus, on irradiation of the system (200 watt bulb) the yield of benzyl chloride increased from 12 per cent. to about 35 per cent. at 9 kV. exciting potential and that of  $C_6H_5Cl_6$  (*vide infra*) increased with the introduction in the annular space of powdered wall material, from 24 to 38-40 per cent.

In the chlorination of benzene under discharge in dark the chief product is  $C_6H_5Cl_6$  as



against  $C_6Cl_6$  produced thermochemically or the familiar addition compound in presence of bright sunlight. Under electrical discharge, benzene yields olefines including ethylene.<sup>2,3</sup> It is known<sup>4</sup> that ethylene reacts with benzene catalytically in the formation of the addition compound under light. That the discharge reaction, even in the absence of special conditions, simulates in part the other types, is shown by the fact that a small but a sensible proportion of the nuclear products ( $C_6H_5Cl$ ) are formed. Thus about 2 per cent. nuclear products are produced in benzene, and 8-10 per cent. in the case of toluene.

The remarkable isomerism exhibited by  $C_6H_6Cl_6$ -hexachlorocyclohexane has been of special structural interest. The  $\gamma$ -isomer (gam-mexane) is an important insecticide.<sup>5</sup> The distribution of these isomers in the products obtained by chlorination under discharge, is not without technical interest. Actual results of the author show that at specially higher exciting potential (12-15 kV.) and under irradiation,  $\gamma$ -, and  $\delta$ -, isomer formation is increased by about 20 per cent.

Grateful thanks are due to Prof. S. S. Joshi, Banaras, for kind help and advice.

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### VITAMIN B<sub>12</sub> IN INFANTILE CIRRHOSIS

RECENTLY Sunder Rao, *et al.*<sup>1</sup> have published their preliminary observations on the therapeutic effect of vitamin B<sub>12</sub> in infantile hepatic cirrhosis. During the past nine months, we have also been engaged on a similar study and are recording here our own experiences.

To date, we have treated in all twelve cases including the early as well as the advanced stages of the disease. Of the cases treated three were early cases with soft, enlarged liver and spleen, four had hard liver and firm spleen, and the rest five cases had jaundice, oedema and ascites when B<sub>12</sub> therapy was instituted.

The vitamin was administered intramuscularly in 30 mcg. doses twice a week. A low fat diet was prescribed. Secondary complications such as temperature, constipation, etc., were treated symptomatically. Two of the

advanced cases without icterus and all the cases with jaundice and ascites were given in addition to B<sub>12</sub> an oral supplement of 25-30 g. casein hydrolysate a day.

The prognosis has been judged on clinical grounds, the restoration of blood picture and serum protein levels and the response to liver function tests. Although there were no strict control cases, the clinical response in these cases has been compared with that produced by a therapeutic regimen comprising protein hydrolysate, liver extract and vitamins of the B-complex which we have found by clinical trials in over five hundred cases to give beneficial results in the early as well as the fairly advanced cases.<sup>2</sup>

All the early cases which were prescribed only vitamin B<sub>12</sub> recovered completely in 4-5 weeks of treatment. Of the advanced cases without icterus or ascites, the two cases which were given the protein hydrolysate supplement in addition to B<sub>12</sub> have shown better general improvement and more rapid recession and softening of the liver than the other two which received only B<sub>12</sub>. These cases are still under observation and treatment. In the icteric stage of the disease, the administration of the vitamin brought about improvement in the general condition of the cases in the first instance but ultimately failed to avert the fatal termination. However, in these cases, the depth of jaundice was much less and the period of survival after the onset of frank icterus longer (6-8 weeks) as compared with similar cases previously observed.

The trend of these preliminary results, which are in general similar to those reported by Sunder Rao, *et al.* indicates that while vitamin B<sub>12</sub> alone may be effective in the early stage of the disease, supplementation with predigested protein produces rapid and satisfactory response in the more advanced condition, and even in the icteric phase tends to arrest the rapid progress of the disease. Further work is in progress.

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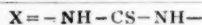
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### THIOCARBAMIDO DERIVATIVES OF DIARYL SULPHONES AND SULPHIDES

IN a previous communication biguanido derivatives of diaryl sulphones and sulphides have been reported. In this part mono- and bis-thiocarbamido derivatives are described. The thioureas were prepared by refluxing the amine with the corresponding mustard oil in an alcoholic medium and purified by dissolving them in alkali and reprecipitating with acid and subsequent crystallisation from alcohol. Some of these compounds have shown marked antibacterial properties in *in vitro* tests.

The melting points of these compounds are recorded below.

R		(R-X-C <sub>6</sub> H <sub>4</sub> ) <sub>2</sub> SO <sub>2</sub>	R-X-C <sub>6</sub> H <sub>4</sub> -S-C <sub>6</sub> H <sub>4</sub> NO <sub>2</sub>	R-X-C <sub>6</sub> H <sub>4</sub> -SO <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> NO <sub>2</sub>
1	C <sub>6</sub> H <sub>5</sub> -	.. 213°	189°	180°
2	<i>p</i> -Cl-C <sub>6</sub> H <sub>4</sub> -	.. 198°	..	..
3	<i>p</i> -Br-C <sub>6</sub> H <sub>4</sub> -	.. 191°	..	92°
4	<i>p</i> -I-C <sub>6</sub> H <sub>4</sub> -	.. 192°	185°	84°
5	<i>p</i> -CH <sub>3</sub> -C <sub>6</sub> H <sub>4</sub> -	.. 208°	..	..
6	<i>o</i> -CH <sub>3</sub> -C <sub>6</sub> H <sub>4</sub> -	.. 206°	..	..
7	<i>m</i> -CH <sub>3</sub> -C <sub>6</sub> H <sub>4</sub> -	.. 210°	..	..
8	CH <sub>2</sub> =CH-CH <sub>2</sub> -	.. 181°	146°	176°
9	<i>o</i> -(CH <sub>3</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>3</sub> -	.. 211°	..	..
10	<i>p</i> -(CH <sub>3</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>3</sub> -	.. 246°	..	..



Attempts to make the corresponding SET and SME compounds from the thioureas were not successful. The unsubstituted bis-thiourea derivative of diamino-diphenyl sulphone also could not be prepared by reacting the base with thiocyanic acid.

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June 12, 1951.

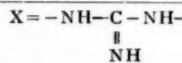
### GUANIDO DERIVATIVES OF DIARYL SULPHONES AND SULFIDES

IN continuation of the work already reported, guanido derivatives of 4:4'-diaminodiphenyl sulfide and sulfone 4-nitro-4'-amino diphenyl sulfide and sulfone, have been prepared with a view to studying their pharmacological pro-

perties. These compounds were obtained by refluxing the amine hydrochlorides with various arylcyanamides in a suitable medium (alcohol) and purified through crystallization from dilute alcohol or water. The aryl cyanamides required for the condensations were obtained by desulfurization of the thioureas prepared from the corresponding amines. The compounds are under pharmacological investigation.

The melting points of the compounds are tabulated below:

R		(R-X-C <sub>6</sub> H <sub>4</sub> ) <sub>2</sub> S	(R-X-C <sub>6</sub> H <sub>4</sub> ) <sub>2</sub> SO <sub>2</sub>	R-X-C <sub>6</sub> H <sub>4</sub> -S-C <sub>6</sub> H <sub>4</sub> NO <sub>2</sub>	R-X-C <sub>6</sub> H <sub>4</sub> -SO <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> NO <sub>2</sub>
1	C <sub>6</sub> H <sub>5</sub> -	.. 154-6°	197-9°	174°	160°
2	<i>p</i> -Cl-C <sub>6</sub> H <sub>4</sub> -	.. 140-51°	183	163°	150-2°
3	<i>p</i> -Br-C <sub>6</sub> H <sub>4</sub> -	.. 139°	170	140°	138°
4	<i>p</i> -CH <sub>3</sub> -C <sub>6</sub> H <sub>4</sub> -	.. 145°	180°	159°	148°



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### THE DEVELOPMENT OF MOTILITY IN THE SPERMATOZOA OF THE ALBINO RAT AND THE GOLDEN HAMSTER\*

Six sexually mature male albino rats and golden hamsters were obtained and chloroformed. The animals were then pithed by breaking the vertebral column at the junction of the head and the neck. The abdomen was then cut open and the entire reproductive tract removed within a few minutes after the unconsciousness of the animals. The secretions from the different regions of the reproductive tract were examined immediately after collection for motility under the microscope without the addition of any diluent. The secretions were spread in a thin layer before microscopic examination, all examinations being carried out at 100° F.

\* This work was completed in August 1948, at the University of Missouri, Columbia, Missouri, U.S.A., when the author was a graduate student in the Department of Animal Husbandry. The encouragement and guidance of Dr. Dennis T. Mayer is very deeply appreciated.

The sperm collected from the testis and the head and body of the epididymis of the rat and the golden hamster showed very poor motility, and only a slight improvement in motility could be noticed on the addition of 0.9 per cent. saline and warming to 100° F. The secretions collected from the tail of the epididymis were thick and viscous but even here with a very high sperm concentration sperm could be seen being gently swept across the microscopic field in waves. The motility is not maximal nor the disturbance in the microscopic field violent in view of the very high sperm concentration and the viscosity of the secretions. It is extremely important that the examination of these preparations should be made quickly since the movement is greatly impeded by the rapid drying of these secretions. The motility of the sperm at once becomes maximal after the addition of a drop of 0.9 per cent. saline or 5 per cent. glucose solution or any other isotonic solution and warming to 100° F. This stimulatory effect on sperm motility appears to be due mainly to the lowering of the viscosity of the secretions as well as to the reduced sperm concentration which renders the lashings of the tails of the sperm more effective and motility more easy. The secretions from the ampulla were less viscous than those from the tail of the epididymis and the sperm motility was very active although not maximal and gentle wave-like movement could be noticed in the microscopic field. The motility becomes maximal soon after the addition of a drop of the diluents mentioned earlier and warming to 100° F. It should be noted, however, that the wave-like motion manifest in preparations from the tail of the epididymis and the ampulla is rather of short duration and quickly stops probably due to partial drying of the viscous secretions. Addition of the above diluents at this juncture throws the sperm into maximal motility. When

secretions from the above-mentioned regions are spread thinly and examined directly with the naked eye, evidence of sperm motility can be obtained by the marked disturbance noticeable in the secretions.

It therefore appears that the sperm of the rat and the golden hamster are differentiated for motility very early in their development just as in the case of the other species already



Deer sperm from the head of epididymis, stained with Weigert's iron hæmatoxylin and safranin. Note the cytoplasmic cap at the anterior end of the acrosome and the cytoplasmic drop at the anterior end of the connecting piece,  $\times 720$ .

studied.<sup>1-5</sup> The ability for maximal motility, however, is attained by the time they reach the tail of the epididymis and it can therefore be presumed that the sperm complete their development and become physiologically mature by the time they reach this region. While the accessory secretions may have important functions to perform in sperm physiology it is doubtful whether these secretions have any

*Motility of sperm from different regions of the male reproductive tract of the albino rat and the golden hamster before and after dilution with isotonic solutions*

Site of collection of material	Albino rat		Golden Hamster	
	Motility before dilution	Motility after dilution	Motility before dilution	Motility after dilution
Testis ..	Very poor	Very poor	Very poor	Very poor
Head of epididymis	do	do	do	do
Body of epididymis	Poor	Poor	Poor	Poor
Tail of epididymis	Wave-like movement of short duration	Maximal motility	Wave-like movement of short duration	Maximal motility
Ampulla ..	do	do	do	do

specific stimulatory effect on sperm motility. Two important ways in which they appear to influence sperm motility seem to be by lowering the viscosity of the ampullar contents and by reducing the sperm concentration, these two factors being sufficient to induce maximal motility in the ejaculated semen. As Walton<sup>6</sup> says, another important function of the accessory secretions appears to be to increase the bulk of the ejaculate and thereby render the urethral contractions more effective.

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#### VIGOUR IN GROUNDNUTS

AFTER harvest, the vegetative portion of the groundnut plant is often employed as a cattle feed or as a green manure. This wholesome practice is by no means common, since frequently the plant dries up at maturity, shedding most of the leaves. In an overall programme devoted to the improvement of this crop, consistent efforts have been maintained to improve the quality and quantity of the top growth thus providing a wider range for its utilization. Mention is made in this preliminary note of a little success achieved in this direction.

In many cases, individuals appear in  $F_2$  having a greater vigour than either of the parents. In subsequent generations, this vigour is as often lost as retained. Usually these vigorous types set either poorly or bear pods of small size. Since 1939, a large number of these vigorous hybrid progenies have been under trial. The object aimed at is to obviate the defects of poor bearing and reduced pod size, while retaining the desirable feature of vigorous top growth.

Two of such hybrids (both bunched in habit) have been under trial at the Visveswariah Canal Farm, near Mandya, under dry land conditions, although there was extra sub-soil moisture. Both of them are hardy, resistant to drought, tolerant to *tacca* (*Cercospora* sp.) leaf spot, and retain the bulk of the leaves till

maturity. The yield of pods compares favourably with commercial types under cultivation. Of these H.G. 5 (G. 0195) a cross of Mysore Local and Spanish, is semi-erect and bears small pods. The pods are two seeded, the surface boldly reticulated and the kernels flesh coloured. The other hybrid between Virginia and Small Japan, H.G. 6 (G. 0689) is more bunched in habit and bears medium sized pods. The two seeded pods are often deeply constricted and slightly misshaped. The kernels are flesh coloured. Their performance under field conditions is as follows:

Variety	Season	Pods per acre in lb.	Haulms per acre in lb.
H.G. 5	1949-50	1,250	16,000
	1950-51	1,100	13,200
H.G. 6	1949-50	1,350	15,000
	1950-51	1,200	12,350

The haulm yield obtained is two to three times more than ordinary.

This work is partly financed by the Indian Central Oilseeds Committee.

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#### SOME OBSERVATIONS ON THE GENICULATE AWNS OF *HETEROPOGON CONTORTUS* ROEM. & SCHULT.

THE awns of ball-forming variety of *Heteropogon contortus* Roem. & Schult. (*Andropogon contortus* Linn.) have the property of performing a right-handed torsion on being moistened. Drying-up produces a reverse movement. Reference to classical literature (Haberlandt) reveals a wealth of morphological and anatomical details bound up with a teleological explanation, viz., that it helps to push the seed into the soil. We have the following reasons to discount this:—

(a) It is possible for the awn to turn even when the seed is held fast.

(b) A number of such seeds were inserted vertically into glass tubes containing agar gels of various concentrations. The awns were then wetted, all the time keeping a horizontal microscope focussed upon the seed to measure its 'boring' movement (if any). In no case was any such movement observed. Neither did the reverse move-



ment tend to pull out the seed from the substratum.

Kerner and Oliver describe the feathery awns of *Stipa pennata* (feathery grass) which are also capable of performing the same movement but they place this factor as subsidiary. According to them, the majority of the boring action is performed by the wind oscillating the awn from side to side thus compressing the upward pointing stiff hairs on the seed which recoil and push the seed in. They further state that the rotating movement anchors the knee-shaped awn against other branches and levers the seed into the soil.

We tend to offer no further explanation—teleological or otherwise—in the present case, but merely wish to record the facts, in support of Huxley's statement that "the greatest tragedy in science is the slaying of a beautiful hypothesis by an ugly fact".

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#### THE PRONEPHROS OF *APLOCHEILUS MELASTIGMA* (McCLELLAND)

GOODRICH<sup>1</sup> has observed that it is a remarkable fact that the pronephros remains functional in some adult Teleosts, like *Fierasfer*, *Zoarces* (Emery<sup>2</sup>) and *Lepadogaster* (Guitel<sup>3</sup>). I have been studying recently the organogenesis of *Aplocheilus melastigma*, and I find in this species a persistence of a functional pronephros in the adult.

In well grown specimens of *Aplocheilus* a pair of prominent pronephric glomeruli are present on the median side of the anterior end of the definitive or mesonephric kidneys. The arterial connections of the pronephros are well developed and indicate its functional nature. A comparison of the condition obtaining in *Aplocheilus* with the description and illustrations given by Guitel<sup>3</sup> for *Lepadogaster* confirms the view that the pronephros of *Aplocheilus* is functional. I have also studied for comparison the adult kidneys of other genera of fish, like *Ophicephalus* and *Therapon*, but in these there is no persistent pronephros.

In this context a few observations on the development of the pronephros in *Aplocheilus* will be relevant. Moghe<sup>4</sup> has stated that there are two views regarding the origin of the pronephros. The pronephric tubules of *Aplochei-*

*lus*, of which there is only one pair, develop independently of the archinephric duct which is developed earlier. Maschkowzeff<sup>5</sup> has traced the origin of the pronephros to the lower part of the nephrotome whose cells have become incorporated in the general body cavity, and finds that in the origin of the mesonephric vesicles the relation to the nephrotome is more distinct. Fraser<sup>6</sup> points out that Maschkowzeff's 'interpretation is the correct one, though his explanation is not convincing'. In *Aplocheilus* there is convincing evidence for the origin of the pronephros from the nephrotome. In a transverse section of an early embryo of about 36 hours a distinct intermediate cell-mass, with a trace of coelomic space constituting a true nephrotome is present on either side. From an examination of serial sections of several early embryos I find that the 'Anlage' of the pronephros in *Aplocheilus* arises from a distinct nephrotome, and the development of the kidneys of Teleosts is not therefore aberrant but falls in line with that of other Vertebrates. Further work is in progress.

My thanks are due to Prof. R. V. Seshaiya for guidance in my work.

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March 10, 1951.

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#### EFFECT OF TANNERY WASTES ON SOIL CONDITIONS AND PLANT GROWTH

TANNERY wastes are generally stored in settling ponds and, after a period of sedimentation and fermentation, they are discharged into the nearest watercourse or on land. In regard to the effects of tannery wastes on soil conditions and plant growth, there is practically no information.<sup>1</sup> Recently, we have carried out some studies on these aspects and the observations are briefly described below.

The liquid wastes from a fair-sized tannery near Madras have been, over a period of about 20 years, run into basins scooped out of earth spread over an area of about 2½ acres adjoin-

ing a stretch of paddy fields and the main irrigation channel from a tank in the neighbourhood. The effluent is allowed to accumulate and stagnate in such ponds and is sometimes, particularly during the rainy season, allowed to overflow, provision not having been made to treat the material and to dispose it of satisfactorily. Continued stagnation of the wastes causes considerable putrefaction giving rise to gases, such as  $H_2S$ ; and the overflow of the material causes heavy incrustations of salts and organic matter around the basins. The effluent basins are situated on a higher level in relation to the agricultural land (sandy loam with low water-holding capacity) and are very close to the latter (being separated by a bund and the irrigation channel), thus causing considerable seepage of the waste material into the adjacent land.

The soil in the area (about 92 acres covering three-fourth of a mile down the tannery effluent basins) has steadily become infertile, some acres of the affected belt of land having completely lost their productive capacity and the others partially. Whitish patches (mostly salts, e.g.,  $NaCl$ ) and blackish flakes (mostly organic matter) both traceable to tannery wastes may be noticed on the soil surface. Characteristic saline vegetation, e.g., growth of salt bushes and nut grasses, may also be seen. Germination of paddy on the fields is very unsatisfactory and in the case of the rice plants that come up the grain formation and the quality of grains are poor. Heavy manuring of these fields has had practically no beneficial effect on plant growth and crop yields. At the same time, satisfactory crop yields are obtained from the adjoining fields containing the same type of soil.

A large number of samples of soils and sub-soil waters from these two contiguous belts, fertile and affected, of the farm-land were examined. One set of results are given in Table I. The tannery effluent had pH values generally ranging between 8.6-10.9, and its composition varied (parts per 100,000): total solids, 1054.4-2294.8; loss on ignition (organic matter), 40.4-124.8; residue on ignition (mineral matter), 1014.0-2170.0;  $SiO_2$ , 5.6-17.2;  $Ca(HCO_3)_2$ , 6.9-23.7;  $Mg(HCO_3)_2$ , 8.4-178.1;  $NaHCO_3$ , 66.8-353.5;  $Na_2CO_3$ , 46.9-111.9;  $Na_2SO_4$ , 15.4-299.1;  $NaCl$ , 547.1-1903.0; Cr, 0.08-0.33; As, traces.

The sub-soil water from the affected area had a pH value of about 8 and had the following composition (parts per 100,000): total solids, 958.4; loss on ignition (organic matter), 36.8; residue on ignition (mineral matter),

921.6;  $SiO_2$ , 16.0;  $Ca(HCO_3)_2$ , 111.5;  $CaSO_4$ , 15.3;  $MgSO_4$ , 32.0;  $Na_2SO_4$ , 130.0;  $NaCl$ , 537.5.

TABLE I

	Fertile area		Affected area	
	0-12"	12"-30"	0-12"	12"-24"
<i>Mechanical composition of soil (%) :</i>				
Coarse sand ..	54.1	44.0	48.6	45.9
Fine sand ..	20.5	23.5	23.5	12.8
Coarse fraction ..	74.6	67.5	72.1	58.7
Silt, fine silt and clay ..	25.4	32.5	27.9	41.3
<i>Physical characteristics :</i>				
Maximum water-holding capacity (%)	37.7	47.1	24.1	—*
Pore space (%) ..	40.7	46.8	28.5	—*
<i>Exchangeable base :</i>				
(in milli-equivalents)				
(a) Sodium & potassium	0.7	0.4	9.5	11.7
(b) Total exchangeable bases	7.1	10.5	18.7	20.8
<i>Degree of alkalisation (%) :</i>				
Ex. $Na + K \times 100$	9.9	3.8	59.8	56.2
Total exchange capacity				
<i>Water extracts of soils (1 : 5) :</i>				
(parts per 100,000)				
Total solids ..	8.8	7.6	130.2	63.4
Mineral matter ..	8.3	7.4	123.4	61.8
$NaHCO_3$ ..	nil	nil	14.9	24.2
$Na_2CO_3$ ..	nil	nil	1.4	2.3
$Na_2SO_4$ ..	nil	0.4	20.2	11.1
$NaCl$ ..	2.6	2.8	83.2	17.0
Cr ..	nil	nil	Traces	Traces
As ..	nil	nil	Traces	Traces

\* Resisted wetting in spite of being left in contact with water layer for over 27 days.

The above observations show that as a result of impounding the waste waters from the tannery close to the arable land, the salts, including toxic substances, from the waste materials soak through the soil and adversely affect the composition of the soil and the conditions for plant growth. The detailed paper will be published elsewhere.

Our thanks are due to Dr. V. Subrahmanyam and Mr. C. V. Ramaswamy Iyer for their valuable suggestions in the course of the work. Dept. of Biochemistry, C. R. HARIHARA IYER. Indian Institute of R. RAJAGOPALAN. Science, Bangalore, S. C. PILLAI. May 2, 1951.

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**A NOTE ON THE OCCURRENCE OF  
MONOSTACHOUS INFLORESCENCE IN  
ELEUSINE INDICA, GAERTN.**

*Eleusine indica*, Gaertn., is a tufted annual grass, with a wide distribution in the tropics of the East, ascending up to about 6,000 feet above sea-level. In the genus *Eleusine*, Gaertn., the inflorescence is described to be polystachous, consisting of two to several digitate capitate or whorled spikes.<sup>1,2,3</sup> In *E. indica* Ranga Achariyar<sup>4</sup> describes: "The spikes are elongate, digitate 2 to 7, 2 to 5 inches long, all in a terminal whorl and sometimes with one or two lower down."

In August 1950, I collected from the area of the Rangoon University campus a number of specimens of what appear to be *E. indica*, but bearing only solitary spikes. Plants bearing such monostachous inflorescences were found growing along with others bearing the usual polystachous type of inflorescence. It was further noticed that in certain specimens, some of the inflorescences consisted of solitary spikes, while others showed two or more spikes. The spikelets in each case were carefully dissected and examined, and no difference was noticed between the monostachous and the polystachous types. Seeds from the two types have been separately collected, and it is planned to test in the following growing season whether the types breed true as regards their inflorescence character. Monostachous types were subsequently seen to occur fairly frequently in other parts of Rangoon as well, indicating that the condition is by no means exceptional.

To my best knowledge, the occurrence of monostachous inflorescence in any of the species of *Eleusine* has not previously been recorded.

The specimens of *E. indica* showing monostachous inflorescences are deposited in the Herbarium of the Rangoon University Biology Department.

Dept. of Biology,  
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March 5, 1951.

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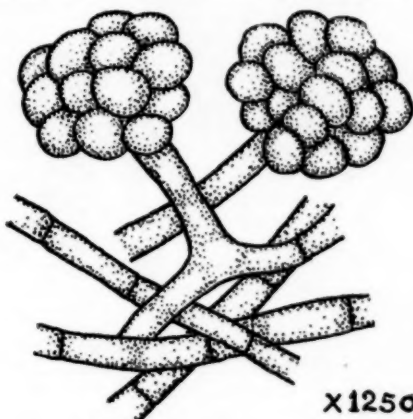
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**AEGERITA WEBBERI ON SCALE  
INSECTS**

ON scale insects (*Aleyrodes* sp.) infesting the leaves of *Holarrhena antidysenterica* Wall., growing in the Botanic Garden, Benares Hindu University Campus, an entomogenous fungus

was collected and identified as *Aegerita webberi* Fawcett. Popularly known as "brown mealy-wing fungus", it has been shown by Fawcett<sup>1</sup> to be of considerable economic importance in the biological control of the scale insects on citrus. The insects on *Holarrhena* were found killed to the extent of 80 to 100 per cent. Unlike as in infection by *Aschersonia* sp., which occurs frequently on scale insects, the stroma of *A. webberi* is compressed, flat, smooth, and imparts a deep brownish-black appearance to the insects.

Microscopic examination revealed that the mycelium spread from the base of the stroma forming a hypothallus. These filamentous hyphae were septate and colourless or tawny-brown with age. The sporodochia were borne on the hyphal strands, bearing aggregation of inflated cells (Fig. 1). Fawcett has shown the



extension of the hyphae to considerable distances on the leaves, bearing the clusters of sporodochia. Considering the degree of mortality inflicted by *A. webberi* on scale insects, this fungus may advantageously be used for the biological control of scale insects (particularly *Aleyrodes* sp.) in India.

College of Agriculture,  
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April, 1951.

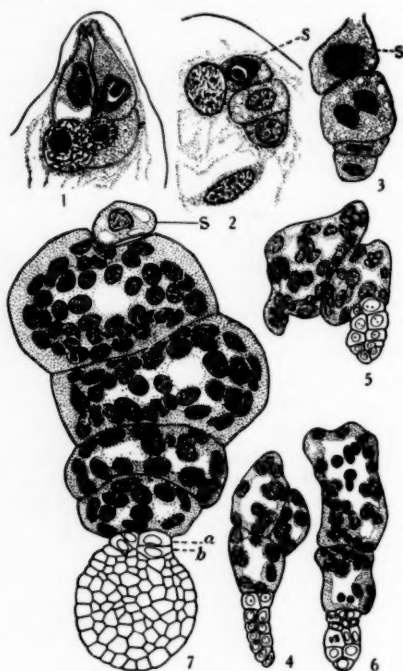
M. S. PAVGI.

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**ENDOSPERM AND EMBRYO  
DEVELOPMENT IN CUSCUTA REFLEXA  
ROXB.**

ALTHOUGH the embryology of *Cuscuta* has been studied by some previous workers,<sup>1,2</sup> the peculiarities found in *C. reflexa* are considered to be worthy of record.

After fertilisation the oospore and the primary endosperm nucleus enlarge (Fig. 1) and divide almost simultaneously. Fig. 2 shows a



FIGS. 1-7

Fig. 1. Upper part of mature embryosac showing oospore, two synergids and primary endosperm nucleus.  $\times 288$ . Fig. 2. Two-celled pro-embryo and two free endosperm nuclei; *s*, persisting synergid in this and some of the subsequent figures.  $\times 288$ . Fig. 3. Three-celled stage with binucleate basal cell.  $\times 288$ . Figs. 4 to 6. Enlarged multinucleate suspensor cells and five to six tiers of cells in the proembryo.  $\times 133$ . Fig. 7. Globular embryonal mass connected to the row of four suspensor cells by two tiers of cells, *a* and *b*, the uppermost suspensor cell shows 42 daughter nuclei.  $\times 133$ .

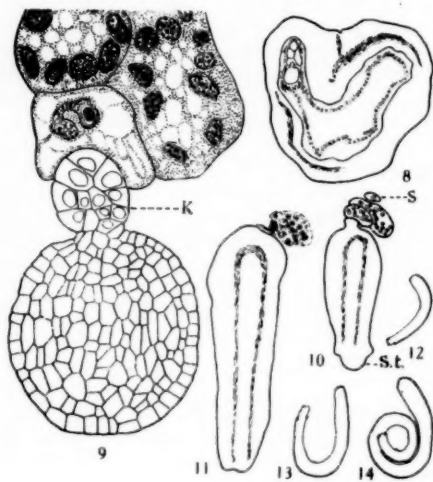
two-celled pro-embryo and two free endosperm nuclei in the upper part of the embryosac. Repeated free nuclear divisions result in a large number of endosperm nuclei, wall formation taking place much later (Fig. 8). An interesting point is that one of the synergids persists until a very late stage and is probably haustorial (Figs. 2, 3, 7 and 10, *s*).

Both the cells of the pro-embryo divide simultaneously resulting in a three-celled stage consisting of the larger vacuolated binucleate basal cell, a middle cell and the terminal cell (Fig. 3). The pro-embryo soon shows five to six tiers of cells besides the suspensor (Figs.

4 to 6). Anticlinical and periclinal divisions at the tip result in a globular mass of cells. Above these are two to four highly vacuolate and multinucleate suspensor cells (Figs. 4 to 8). Their nuclei divide mitotically and as many as 42 daughter nuclei have been counted in a single cell (Fig. 7). Thus the suspensor forms an aggressive haustorium comprising nearly three-fourths of the total length of the embryo (Fig. 7).

Two tiers of cells form a short neck between the suspensor and the globular mass of embryonal cells (Fig. 7, *a* and *b*). This develops into a knob-like projection pushing into the suspensor cell lying immediately above it (Fig. 9, *k*). Eventually with the further enlargement of the embryo proper the knob as well as the suspensor cells disintegrate and form a dense mass at its micropylar end (Fig. 11).

During its further growth the embryo becomes twisted and spirally coiled around itself (Figs. 12 to 14). The provascular strands and the stem tip can be identified at an early stage (Fig. 10, *s. t.*), but in accordance with the condition in many other parasites no cotyledons are distinguishable. Minute protuberances are seen on the hypocotyl and the stem tip which appear to be scale leaves but I have not yet followed their further development.



FIGS. 8-14

Fig. 8. L. s. ovule showing vascular supply reaching far up into the integument.  $\times 9$ . Fig. 9. Enlarged view of embryo shown in Fig. 8; note knob like projection, *k*, pushing into the adjacent suspensor cell.  $\times 133$ . Figs. 10 and 11. Elongated young embryo with stem tip, *s. t.*, already differentiated and suspensor cells crushed.  $\times 30$ . Figs. 12 to 14. Young and mature embryos,  $\times 3$ .



Since the nucellus is absorbed early there is no perisperm but the endosperm which becomes cellular persists in the seed. In the testa the epidermis is followed by a layer of smaller cells. The cells of the third and occasionally the fourth layer are radially elongated and have prominent nuclei. Finally there are ten to twelve layers of thin-walled cells of which the inner are crushed due to the enlargement of the embryo-sac. The vascular supply reaches far up into the integument and consists of prominent tracheids with spiral thickenings (Fig. 8).

I have pleasure in expressing my indebtedness to Prof. P. Maheshwari for his help.

B. M. JOHRI.

Dept. of Botany,  
University of Delhi,  
April 21, 1951.

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# BACTERIAL SOFT-ROT OF PEAS

IN the winter of 1949, green peas were found to be affected with soft-rot in the Delhi markets. The diseased pods always yielded colonies of a greyish-white bacterium. This bacterium, after purification by single-colony-culture method, was inoculated into healthy pods of peas by the procedure followed by Townsend (1904) when symptoms identical with the natural infection were produced. The pods showed yellow discolouration from outside but seeds within were completely transformed into a soft mushy bacterial mass which emitted foul odour. The organism was also found to infect potatoes, carrots, cucumber, tomato, chillies, radish, beet, brinjal, cauliflower and several other vegetables. Bacterial soft-rot of peas was found in occasional lots affecting 2 to 5 per cent. of the stock on the Chicago market in 1936 by Ramsey (1937).

**Morphology.**—The bacterium is a short rod with rounded ends, occurring singly or in pairs, occasionally in chains; actively motile by peritrichic flagella; Gram-negative, non-capsulated, non-spore forming, and not acid-fast. The size of the cells is  $3.49 \times 0.76 \mu$  (negative staining).

**Cultural Characters.**—On nutrient agar slants the growth is moderate, spreading, raised, entire, moist-glistening and dirty-white in colour. Growth in nutrient broth is abundant with the formation of pellicle and abundant flaky sediment. Colonies on the surface of potato-dextrose agar plates are circular, elevated, smooth,

glistening, have sharp margins and pale olive-grey colour, and with no distinctive odour. On potato cylinders the growth is profuse, shining and creamy-white. The pathogen grows on media with pH ranging from 5.0 to 9.0, the best growth occurring at pH 7.0. The optimum temperature for growth is between 20° to 35° C., maximum 45° C., and minimum 4° C. The thermal death point lies close to 55° C.

**Physiological Characters.**—The pathogen is a facultative anaerobe, nitrate reducer but failing to produce ammonia, milk and litmus curdler with acid reaction and no peptonization in the latter. In tryptophane broth, hydrogen sulfide is not produced even after 15 days' growth. Ehrlich-Bohme method shows positive but feeble reaction for indole. Starch is not hydrolyzed. The isolate further gives negative reaction to M.R. and V.P. tests and requires from 13 to 22 days to liquify gelation. Acid without gas formation takes place from dextrose, lactose, sucrose, maltose, mannitol, glycerol, levulose, raffinose, arabinose, and xylose. The carbon source media, respectively, were prepared by adding 2 per cent. by weight of the designated compound, before sterilization, to nutrient broth containing 3g. of beef extract and 5g. of peptone per litre.

**Identity.**—The bacterium causing rot of green peas herein described appears to belong to the group of intermediates mentioned by Stanley (1938), who reports that 44.0 per cent. of cultures isolated from soft-rots are intermediate between *Erwinia caratovora* (Jones) Holland and *Erwinia aroideae* (Townsend) Holland. It resembles the two pathogens in its morphological and cultural characters, and most of the physiological characters. It agrees with *E. caratovora* in failing to produce hydrogen sulfide and ammonia, diastase negative, and in positive test for indole. It is like *E. aroideae* in its lack of gas formation from the carbohydrate media and in the negative reaction to M.R. and V.P. tests. The pea isolate is, however, unlike both *E. caratovora* and *E. aroideae* in being a slow gelatin liquifier (13 to 22 days) and in having slightly higher thermal death (55° C.).

Thanks are due to Dr. R. S. Vasudeva for helpful suggestions and criticism.

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Indian Agric. Res. Institute,  
New Delhi,  
April 26, 1951.

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## REVIEWS

**Radio Operating Questions and Answers.** By J. L. Hornung. Tenth Edition. (McGraw-Hill Book Co., Inc., New York, N.Y.), 1950. Pp. 588. Price \$4.00.

This is a book designed to meet the requirements of the students appearing for the radio telegraph and telephone operators' license examinations conducted by the Federal Communications Commission of U.S.A. In this country it will be found equally useful to students who have to face the *viva voce* examinations of the various Polytechnics in Radio Technology and to those that take the Radio Operators' Certificate Examinations.

The questions and answers cover basic radio laws, theory and practice, radio telegraphy and telephony and aircraft radio. A special problem section which deals with problems relating to antenna systems, loran and radar has been added to this new 10th edition. That something like 2,000 questions have been answered in about 500 pages should make it clear to the student that this book is intended to serve only as a guide to study and not as a text-book.

A work that is expected to be consulted almost solely by examinees should avoid mistakes such as " $\lambda$  = wavelength in metres per

second" on p. 90, " $X_c = \frac{16^6}{2fC}$  ohms" on p. 102,

"Turns ratio =  $\frac{Z_1}{Z_2}$ " on p. 216, etc. Answers

to Q. 4.114 and Q. 4.145 bear no relation to the questions. The solution to problem 36 as indicated on p. 533 is likely to convey the wrong impression that the pulse repetition period is the ratio of the peak pulse power to the average power and is independent of the pulse duration. The answer to problem 28 (p. 529) is misprinted as 1,199.180 KC/sec. instead of 1,199.280 KC/sec. Barring a few errors of this type, the book can be recommended to the class of readers it is intended to serve. R. L. N.

**Introduction to Statistical Analysis.** By W. J. Dixon and F. J. Massey. (McGraw-Hill Book Company, Inc.), 1951. Pp. 370. Price \$4.50.

This book is a welcome change from the series of books that have been appearing for some time on specialised aspects of statistical theory and application. Covering a variety of topics from elementary ideas of statistical populations, measures of central tendency, dispersion, etc., to advanced concepts of statistical

inference such as testing of hypothesis, confidence intervals, sequential and non-parametric tests, the book presents the logical problem in each case and the computational methods of solution without any attempt to justify the formulae used. While a routine practical worker may feel happy that he is spared of all the mathematical analysis, a student of statistics may genuinely complain against the complete absence of mathematics. For instance, the authors set up a 90 per cent. confidence for  $\sigma^2$  by considering the lower 5 per cent. and upper 5 per cent. values of  $\phi^2$ . Why this way? Why not consider the 6 per cent. point at the lower end and the 4 per cent. at the upper end? In fact there is satisfactory answer to this problem and the way the authors state does no justice to the problem of interval estimation of  $\sigma^2$ .

The authors define variance by the sum of squared deviations divided by  $(N-1)$ . There is no particular virtue in such a definition and this might lead to a confusion of terminology. The above statistic may be specifically mentioned as an unbiased estimate of the variance in the population which might consist of a finite or an infinite set of elements.

As a general treatise on the scope of statistical methods this book is useful for the beginners as well as the professional statisticians with all the references, glossaries, discussion questions, class exercises and problems it contains. Some added attractions of this book are a description of the punched card technique in large scale computations and a number of appendices containing useful numerical tables.

C. RADHAKRISHNA RAO.

**Industrial Applications of Gasfilled Triodes (Thyratrons).** By R. C. Walker. (Published by Chapman and Hall, London, W.C. 2). Pp. ix + 325. Price 40 sh. nett.

This book is a welcome addition to the scanty literature available on the subject. It deals with the hot cathode grid-controlled thyatrons, their operating characteristics and the underlying physical theory. Methods of control by grid amplitude and phase change are explained in detail. Considerable attention is given to industrial applications. Cold cathode triodes, ignitrons, photoflash bulbs, etc., are also dealt with.

The book is divided into eight chapters. The hot cathode gas-filled valve, the gas-filled

tetrode, the basic circuits using such triodes, applications of the gas-filled triode as a switching device and in relay circuits, indicating, controlling and measuring devices, voltage and current regulator applications and commutating devices come up for treatment in separate chapters. The last chapter is devoted to other types of grid-controlled gas-filled valves. Each chapter is a well balanced account of the topic under discussion. The treatment is clear and the information is mostly accurate.

The printing and get-up of the book are of the high standard we have come to expect of the publishers. There are several diagrams in the book. All of them are neatly drawn and well reproduced. There are excellent photographs of typical tubes to explain their constructional features. There is a very valuable and well selected bibliography at the end of each chapter. This increases the utility of the book to those interested in further investigations.

The book can be strongly recommended to electrical and communication engineering and physics libraries. The honours student will find much that is valuable to him in the book.

S. V. CHANDRASHEKHAR AIYA.

Science in Fisheries. By Lorne Manchester.

(Reprinted from the *Canadian Geographic Journal*), Department of Fisheries, Ottawa, Canada, 1951. Pp. 23. Photographs 34.

This attractively illustrated booklet briefly describes how scientific researches conducted for over half a century have contributed to the development of fisheries in Canada. In view of the various fishery research programmes now in operation under the auspices of the Indian Union and State Governments and the scepticism that is often expressed regarding the utility of such work, this publication will be of special interest to readers in India.

The booklet sets forth a very satisfactory and encouraging record of achievements in fishery development made by the Fisheries Research Board of Canada, which consists of fifteen members drawn from the Universities, Department of Fisheries and the Fishing Industry.

The most striking contribution made by the Board appears to be the exploratory surveys which led to the discovery of new resources such as the rich fishery of the Great Slave Lake in N.W. Territories, the rosefish stocks of the Hermitage Bay, new supplies of American plaice and cod down the eastern edge of the Grand Bank, a new source of supply of the Winnipeg goldeye in Lake Claire, etc. On the biological

side, the studies on the flounder, Pacific and Atlantic salmon, lobsters, oysters, seals, etc., have enabled the development and successful management of their fisheries. The intensive study of catch fluctuations have served to provide a very adequate management policy resulting in a maximum sustained fishery. Researches on oysters led to oyster culture and investigations on seaweeds have contributed to development of the Irish moss industry.

Technological research, both for the improvement of the fishing gear and the full utilization of fish products were conducted by the Board and its achievements in this line are varied and interesting. The development of flounder dragging, experimental fishing with different types of nets and the detection of fish schools by echo sounders aided by other electrical devices in mid layers of water where their existence was unknown, are some of the important items mentioned. Investigations on fish processing have been responsible for improvements in preservation methods, especially refrigeration, salt-fish drying, canning and recovery of edible flesh from fish wastes; and these have helped in saving large sums of money to the industry. Several bye-product industries, such as the preparation of albumin from fish as an egg-white substitute and the production of peptones from fish waste, have been built up. The "animal protein factor" of different Canadian fishes and fish products have been determined to demonstrate their food value. Other important contributions are the development of a new method by which 85 per cent. of the oil from cod livers could be extracted, the preparation of a highly palatable margarine oil, the development of processes for obtaining protamine from salmon milt, insulin from halibut, lingcod and whales, and decolourizing carbon from herring scales.

A notable fact is that the results of the Board's researches are applied in the field of development through the operation of the Department of Fisheries and made freely available to the fishing industry, who appear to have been quick and ready in making use of the findings. Many of the items of research have direct applied value to the industry. But a few schemes, especially those concerning biological researches, have a long-range outlook. A correct approach has been made in every branch with a clear conception of the objectives, and it is surely wise planning that has enabled a comparatively small group of scientists to make such outstanding contributions to the development of the industry in Canada.

T. V. R. PILLAY.

**Problems in Chemistry for Advanced Students.**

By Messrs. Y. G. Lele, G. B. Kolhatkar and K. R. Jog. (Dastane Brothers' Home Service, Poona), 1950. Pp. 196 + 96. Price Rs. 5.

The book is a re-issue of the authors' *Problems in Organic Chemistry and Problems in Physical Chemistry* in one volume, and is bound to be useful to students of Chemistry of the B.A., B.Sc. and M.Sc. courses in our Universities.

**Adaptation and Origin in the Plant World.** By

F. E. Clements, E. V. Martin and F. L. Long. (Waltham, Mass: The Chronica Botanica Co.), 1950. Pp. 332. Price \$ 6.00.

This exquisite Plant Ecological treatise is quite unlike the usual text-books appearing on the subject. The book summarises the results of a long-range project on plant adaptation and origin conducted by the late Drs. F. E. Clements and F. L. Long with the collaboration of Dr. E. V. Martin at the Santa Barbara (sub-tropical marine) and Pikes Peak (Alpine) experimental gardens and laboratories. Thoroughness of planning this large-scale experimentation is seen in every chapter of the book and is typical of all field experimental work conducted in American Ecological laboratories. Some of the important chapters in the book are: Behaviour, Factors and Control, Functions, Ecogenesis, Controlled Experiments, Experimental Morphology and Phylogeny. Of particular interest to research workers in this country would be the simplicity of the instrumentation and the very elaborate results derived from that simple lay-out. Most of the physiological set-up used in these investigations is what could be normally rigged up in many Indian Botanical Laboratories and this book clearly sets one thinking on the need to overcome complacency and start vigorous schools of research in Plant Ecology in many University centres in India.

The strong point of the publication is its fine get-up and splendid illustrations, credit for which goes to Mrs. E. S. Clements. There are a few weak spots, however, the most important of which relates to the lack of any suggestion on the need for using statistical interpretation of the various field data on speciation, growth-rate and transpiration measurements, chemical and physical soil analyses, etc. There are obvious disadvantages when statistical interpretation of voluminous data is not resorted to, the most important of them being the cautious conclusions that one is inclined to draw. Although this cautious attitude is not evident in this book mainly because of the other advan-

tages the authors have had, viz., elaborate nature of the planning and the long period over which the observations have been made, yet the possibilities of obtaining a more uniform interpretation of the various experimental results by applying statistical methods cannot be ruled out.

There should be no hesitation in recommending this book to all botanical workers engaged in routine teaching as well as those interested in plant ecological research and general problems of morphogeny, phylogeny and evolution.

T. S. S.

**Scientific and Learned Societies of Great**

**Britain.** A hand-book compiled from Official Sources. (George Allen & Unwin, Ltd.), 1951. Pp. 227. Price 30 sh. nett.

Previously called the *Year-Book of Scientific and Learned Societies*, this hand-book makes a welcome return after eleven years. It is now arranged in two parts.

Part I, included for the first time, deals with the organization of scientific research in Great Britain and gives the names and addresses of the main research establishments administered by the Department of Scientific and Industrial Research, the Medical Research Council, the Agricultural Research Council, and the Research Association. A valuable chart is included, showing the relationships which exist between bodies engaged upon scientific research in Great Britain.

Part II follows the previous editions and gives full details of more than 600 societies in Great Britain, including the objects and publications of the society concerned, the membership subscriptions, meeting times and principal officers. The societies are listed alphabetically, and are classified.

**Register of Scientific and Technical Personnel**

The second part of the first volume of the *National Register of Scientific and Technical Personnel* has just been published by the Council of Scientific and Industrial Research. It contains the names of engineers—civil, electrical, mechanical, chemical, mining, marine, automobile, aeronautical and communication—who furnished particulars for registration after the issue of the first part in September, 1949.

The information given in this register includes in brief outline, academic and professional qualifications, practical experience—nature and scope, address, present occupation, nature of employment, etc., of qualified engineers in India. At the end of the volume is



given a classified statement of the numbers of engineers under different categories and a brief account of Engineering Organizations and Societies and Technical Education in India.

**Annals of the New York Academy of Sciences:**  
Volume 51, Article 6. Pages 1001-1122: *Methodology and Techniques for the Study of Animal Societies*. New York, 1950.

The present publication is a collection of the eleven papers presented at a symposium on Methodology and Techniques for the study of Animal Societies promoted jointly by the New York Academy of Sciences and the New York Zoological Society, in the fall of 1948.

Some idea of the nature and scope of the papers can be gathered from their titles:—General plans and methodology for field studies of the naturalistic behaviour of animals by C. R. Carpenter; The social behaviour of dogs and wolves: an illustration of sociobiological systematics by J. P. Scott (page 1); The relationship between observation and experimentation in the field study of behaviour by T. C. Schneirla; Measurement of some physiological reactions to Arctic conditions by Laurence Irving; Instruments for the measurement of physiological reactions of unrestrained animals by J. L. Fuller; Effects of nutrition and diseases on experimental animals by L. J. Goss; A study of the phylogenetic or comparative behaviour of three species of grouse by J. W. Scott; Social life and the individual among vertebrate animals by N. E. Collias; The isolation of factors of learning and native behaviour in field and laboratory studies by B. F. Riess; Techniques for observing bird behaviour under natural conditions by J. T. Emlen; The study of wild animals under controlled conditions by J. B. Calhoun.

Anyone expecting in this work a simple manual on the study of animal societies will frankly be disappointed as it is rather a collection of serious essays on various aspects of the subject by leading workers in different fields and on different groups of animals which form the foundation for a new discipline called sociobiology. What part sociobiology would play in the coming years will be watched with no ordinary interest by thinking men everywhere.

Barring a few minor blemishes—such as illy-conceived for ill-conceived on p. 1094, line 11, presumable for presumably on p. 1096, line 20 and 20 feet for 100 feet in the legend below

diagram in Fig. 1, p. 1114—the publication is excellent. The summary and bibliography of significant references accompanying most of the papers, add to its usefulness. The book can be warmly recommended to any one interested in such studies.

N. G. P.

**The Biochemistry of Fish.** *Biochemical Society Symposia* No. 6, 1951. (Published at the University Press, Cambridge). Pp. 105. Price 12 sh. net.

The introduction by Prof. R. A. Morton stresses the importance of research on the applied biochemistry of fish. In the first paper, the comparative aspects of fish biochemistry with particular reference to nitrogen metabolism and blood composition of the marine and fresh-water fish as well as teleost and elasmobranch species of fish have been discussed. The paper on proteins of fish is of particular interest in view of the recent researches on the chemistry of muscular contraction. Fish as a class belong to a lower order of vertebrates and it may be expected that the chemical processes accompanying muscular contraction in fish muscle are less complex than in the mammalian muscle. In this paper, the recent work carried out on the fractionation of various proteins in fish muscle and some of their physicochemical properties have been discussed. The chapter on the nitrogenous extractives deals with the differences in the composition of various species of fish with respect to the non-protein nitrogen. A knowledge of the nitrogenous extractives is of importance in the study of nitrogen metabolism as well as spoilage of fish. The paper on the chemistry and metabolism of fats by Dr. Lovern, an eminent worker in this field, discusses the relationship between the dietary and depot fats of a number of species of fishes. The depot fats of fish are more complex in composition than those of terrestrial animals. The carotenoids of fish have been discussed in another paper by T. W. Goodwin. Marine zooplankton seem to be the main source of vitamin A in marine fish while freshwater copepods seem to be source of vitamin A<sub>2</sub> in freshwater fishes.

This monograph is well printed and contains valuable information for those interested in the biochemistry of fish. Its value would, however, have been enhanced if the discussions on the individual papers had also been recorded.

G. N. SUBBA RAO.

## SCIENCE NOTES AND NEWS

*Jussieua suffruticosa*

Sri. M. S. Chandrasekhar, Curator, Botany Section Government Museum, Madras, writes as follows:—

On the crest of the Bannerghatta Hill (4,480 ft. above sea-level) near Bangalore, *Jussieua suffruticosa* was found growing in association with *Scirpus articulatus* on dry silt. Such occurrence of this plant on dry soil appears to be unpublished hitherto.

## Research Degree Awards

[On the recommendation of a Board of Examiners consisting of Prof. Eric K. Rideal and Prof. S. K. Bhattacharya, Sri. S. Vedaraman, M.Sc., of the Indian Institute of Science, Bangalore, has been awarded the Ph.D. Degree of the University of Bombay, for his thesis on "Adsorption Studies on Catalysts of Industrial Importance".

On the recommendation of a Board of Examiners consisting of Professors A. I. Vogel, H. Vincent, A. Briscoe and E. K. Rideal, Sri. M. Narasimha Sastry, M.Sc., has been admitted to the Doctor of Science Degree of the Andhra University for his thesis on "Newer Methods in Volumetric Analysis."

## Reviews of Pure and Applied Chemistry

The Royal Australian Chemical Institute has begun publication of a new quarterly journal, "Reviews of Pure and Applied Chemistry," replacing the earlier "Journal and Proceedings". The first number, issued in March, contains reviews and general articles covering important aspects of pure and applied chemistry.

## Annual Prize for Popularisation of Science

An international annual prize of 1,000 pounds sterling for the best works of scientific popularisation has been established by Mr. M. B. Patnaik, an Indian Industrialist, and will be awarded under the auspices of UNESCO, bearing the name of *Kalinga*. In co-operation with the International Council of Scientific Unions, UNESCO, will draw up and publish the rules for competition for the prize; and the first award will be made in 1952.

## Watumall Foundation Essay Contest

Watumall Foundation is offering seven prizes for the best essay on "Population Control

in Relation to Food in India" the highest prize being Rs. 3,000. Essays must be in English, not exceeding 3,000 words and must deal with the problem and its solution. They are to be submitted to Mr. J. Watumall, Kishore Buildings, Kalbadevi Road, Bombay 2, before August 12, 1951.

## New Jute Pest

*Fusarium*, not hitherto known to be a jute parasite, has been detected to cause damage to jute plant recently at Tarakeswar (W. Bengal). Heavy wilting of jute plants was reported from Tarakeswar. The affected plants, on examination at the Agricultural Research Institute of the Indian Central Jute Committee, were found to have *Macrophomina* associated with *Fusarium*. Some specimens of the diseased plant gave *Fusarium* only on isolation. It now appears that *Fusarium* is an important soil-borne parasite of *Corchorus olitorius*.

## ISCA Memoranda to UNESCO

The 60-page Memoranda recently issued by the Indian Science Congress Association in reply to a request by the UNESCO embodies reports on the following subjects: Energy and Power Resources of India; Science Clubs in India; Popularisation of Science through Books; and International Collaboration between Existing Associations for the Advancement of Science.

## World Medical Association

The Annual General Assembly of the World Medical Association will be held in Stockholm in September of this year, when Dr. Dag Knutson, who is Assistant Physician at the Karolinska Hospital and President of the Swedish Medical Association, will take over the presidency from Dr. Elmer L. Henderson. It is expected that about 200 delegates and alternate delegates will be present at the meeting.

## ERRATUM

Vol. 20, No. 4, p. 102, in the note on "Potato Pyrophosphatases",— Reference No. 5 should read as follows:

Pfankuch, E., *Z. Physiol. Chem.* 1936, 241, 34.